

In re: Application of Ekwuribe et al.
Serial No.: 09/429,798
Filed: 29 October 1999
Page 20

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the specification:

Please insert pages 1-20 of the enclosed sequence listing after the claims.

Please replace the following paragraphs:

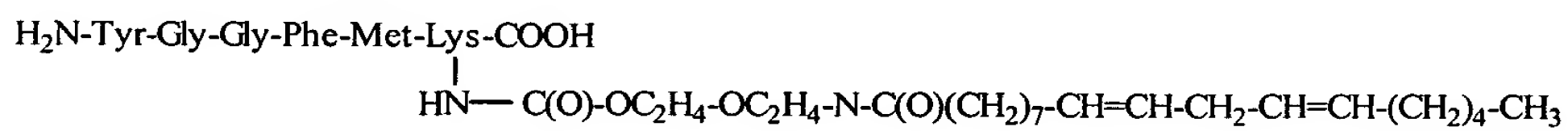
At page 11, lines 4-9:

"For example, in one aspect, the lipophile and hydrophile are connected by hydrolyzable bonds. It is [prefered] preferred to provide hydrolyzable bonds between the fatty acid and the hydrophilic moieties. This permits hydrolysis to occur after penetration into the CNS, thus releasing the active peptides with the hydrophilic group still attached to the peptide. As a result, the peptide acquires a more hydrophilic character and efflux to the circulatory system is thereby hindered."

At page 11, line 19:

"DHA MET-ENKEPHALIN-LYS (SEQ ID NO:1)"

At page 11, lines 25-29:



"LINOLEIC MET-ENKEPHALIN-LYS (SEQ ID NO:1)"

At page 11, line 40:

"CETYL MET-ENKEPHALIN-LYS (SEQ ID NO:1)".

At page 12, line 16:

"CHOLESTEROL MET-ENKEPHALIN-LYS (SEQ ID NO:1)".

At page 12, line 29:

"PALMITATE MET-ENKEPHALIN-LYS (SEQ ID NO:1)".

At page 12, line 44:

"DI-PALMITATE-TEG MET-ENKEPHALIN-LYS (SEQ ID NO:2)".

At page 13, lines 14-15:

For the enkephalin analogues, the preferred peptides are leu-enkephalin lysine (SEQ ID NO:50) and met-enkephalin lysine (SEQ ID NO:49). The amino acid side chain of the lysine is preferably utilized in bonding.

At page 13, lines 18-22:

"In another aspect, the amphiphilic drug-oligomer conjugates moieties are configured as follows:

R-OCH₂CH₂OCH₂CH₂C(O)OCH₂CH₂CH₂OCH₂CH₂CH₂NH-Enkephalin (SEQ ID NO:1); or
R-OCH₂CH₂OCH₂C(O)OCH₂CH₂NH-Enkephalin (SEQ ID NO:1).

Wherein R=alkyl₁₋₂₆, cholesterol or amantane."

At page 17, lines 5-6:

"3.2 FIGURE 2: Compares the stability of the cetyl-PEG2-enkephalin-lys (SEQ ID NO:1) conjugate (non-hydrolyzable) to unconjugated enkephalin (SEQ ID NO:48) in rat brain homogenate."

At page 17, lines 7-8:

"3.3 FIGURE 3: Compares the stability of the cetyl-PEG3-enkephalin (SEQ ID NO:1) conjugate (non-hydrolyzable) to unconjugated enkephalin (SEQ ID NO:47) in rat brain homogenate."

At page 17, lines 9-10:

"3.4 FIGURE 4: Compares palmitate-PEG3-Enk (SEQ ID NO:1) conjugate (hydrolyzable) to unconjugated enkephalin (SEQ ID NO:47) in rat brain homogenate."

At page 17, lines 13-14:

"3.6 FIGURE 6: Graph demonstrating competitive binding between cetyl-PEG₂-enkephalin (SEQ ID NO:1) conjugate and naloxone, an Opioid μ receptor agonist."

At page 17, lines 15-16:

"3.7 FIGURE 7: Graphic comparison of analgesic effect of cetyl-PEG₂-enkephalin (SEQ ID NO:1) with clonidine (a morphine substitute)."

At page 18, lines 11-17:

"The amphiphilic oligomers are composed of lipophilic and hydrophilic moieties. The lipophilic moieties are preferably natural fatty acids or alkyl chains. The [lipophilic] hydrophilic moieties are preferably small segments of PEG, having 1 to 7 PEG moieties, and preferably having 1 to 5 PEG moieties. The length and composition of the lipophilic moieties and the hydrophilic moieties may be adjusted to obtain desired amphiphilicity. For example, the carbon chains of the fatty acid or alkyl moieties may be lengthened to increase lipophilicity, while PEG moieties may be lengthened to increase hydrophilicity."

At page 20, lines 1-3:

"The covalent bond between the oligomer and the drug is preferably amide (a carboxy group of the oligomer is linked to an amine group of the peptide), or carbamate ([an] a chloroformate group of the oligomer is linked to an amine group of the peptide)."

At page 20, lines 4-10:

"For non-peptide drug, the bond is preferably ester (a carboxy group of the [peptide] drug is covalently coupled to a hydroxyl group of the oligomer or a carboxy group of the oligomer is

covalently coupled to a hydroxyl group of the drug), amide (a carboxy group of the oligomer is linked to an amine group of the drug) or carbamate (a chloroformate group of the oligomer is linked to an amine group of the drug). For the enkephalin analogues, the preferred peptides are leu-enkephalin lysine (SEQ ID NO:50) and met-enkephalin lysine (SEQ ID NO:49). The amino residue of the lysine is preferably utilized in bonding."

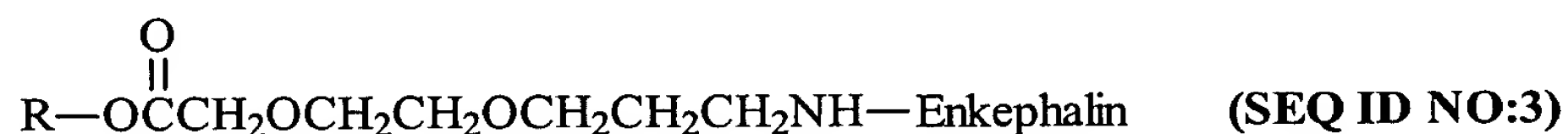
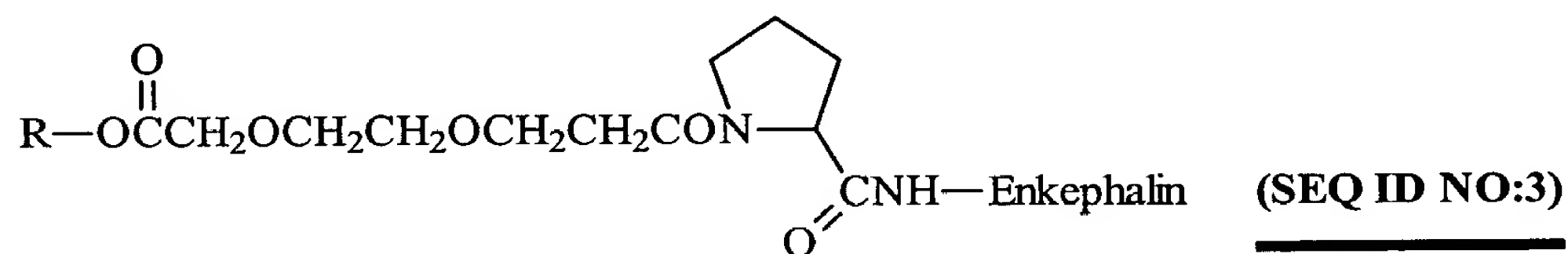
At page 20, line 24-27:

"In another aspect, the oligomer is attached to the C-terminus of the peptide drug. For example:

R-OCH₂CH₂OCH₂C(O)OCH₂CH₂CH₂OCH₂CH₂CH₂NH-Enkephalin (SEQ ID NO:1); or
R-OCH₂CH₂OCH₂C(O)OCH₂CH₂NH-Enkephalin (SEQ ID NO:1)."

At page 21, lines 2-9:

"In another aspect, the oligomer is attached at the N-terminus of the peptide drug. For example:



It will be appreciated by one of skill in the art that the oligomers may be attached at the carboxy terminus or at a constituent of an amino acid side chain, such as a the amino group of lysine."

At page 24, lines 10-15:

"While the description is primarily and illustratively directed to the use of enkephalin as a peptide component in various compositions and formulations of the invention, it will be

appreciated that the utility of the invention is not thus limited, but rather extends to any peptide species which is capable of conjugation to the oligomers herein described, or which [are] is capable of being modified, as for example by the incorporation of a proline residue, so as to enable the peptide to be conjugated to the oligomers described herein."

At page 24, line 28 through page 25, line 11:

"In another [other] aspect, the therapeutic peptide of the amphiphilic drug-oligomer conjugates are as described in United States Patent 5,641,861, which is incorporated herein by reference, so long as any of such peptides contains a lysine residue. Exemplary peptides described therein include: Ac-Phe-Arg-Trp-Trp-Tyr-Lys—NH₂ (SEQ ID NO:4); Ac-Arg-Trp-Ile-Gly-Trp-Lys—NH₂ (SEQ ID NO:5); Trp-Trp-Pro-Lys-His-Xaa—NH₂ (SEQ ID NO:6), where Xaa can be any one of the twenty naturally occurring amino acids, or Trp-Trp-Pro-Xaa—NH₂ (SEQ ID NO:7), where Xaa is Lys or Arg; Tyr-Pro-Phe-Gly-Phe-Xaa—NH₂ (SEQ ID NO:8), wherein Xaa can be any one of the twenty naturally occurring amino acids; (D)Ile-(D)Met-(D)Ser-(D)Trp-(D)Trp-Gly_n-Xaa—NH₂ (SEQ ID NO:9), wherein Xaa is Gly or the D-form of a naturally-occurring amino acid and n is 0 or 1, peptides of this formula can be hexapeptides when Gly is absent (n is 0) and heptapeptides when Gly is present (n is 1); (D)Ile-(D)Met-(D)Thr-(D)Trp-Gly-Xaa—NH₂ (SEQ ID NO:10), wherein Xaa is Gly or the D-form of a naturally-occurring amino acid; Tyr-A1-B2-C3—NH₂ (SEQ ID NO:11), wherein A1 is (D)Nve or (D)Nle, B2 is Gly, Phe, or Trp, and C3 is Trp or Nap; Pm and red {Me_xH_yN-Tyr-(NMe)_z-Tyr-Xaa_z—NH₂} (SEQ ID NO:12), wherein x and y independently are 0,1, or 2 and z is 0 or 1, and wherein Xaa is Phe, D-Phe, or NHBzl; Trp-Trp-Pro-D4-His_z-Xaa_z-NH₂ (SEQ ID NO:13), wherein z is 0 or 1, D4 is Lys or Arg and Xaa is any one of the naturally-occurring amino acids."

At page 25, lines 12-26:

"In still another [other] aspect, the therapeutic peptide of the amphiphilic drug-oligomer conjugates are as described in United States Patent 5,602,099, which is incorporated herein by reference. with the proviso that the conjugation can occur only where there is a free

carboxyl or free N-terminal. Exemplary peptides include: H-Tyr-Tic-Phe-Phe-OH (SEQ ID NO:14); H-Tyr-Tic-Phe-Phe-NH₂ (SEQ ID NO:15); Tyr(NaMe)-Tic-Phe-Phe-OH (SEQ ID NO:16); Tyr(NaCpm)-Tic-Phe-Phe-OH (SEQ ID NO:17); Tyr(NaHex)-Tic-Phe-Phe-OH (SEQ ID NO:18); Tyr(NaEt₂)-Tic-Phe-Phe-OH (SEQ ID NO:19); H-Dmt-Tic-Phe-Phe-OH (SEQ ID NO:20); H-Dmt-Tic-Phe-Phe-NH₂ (SEQ ID NO:21); H-Tyr(3-F)-Tic-Phe-Phe-OH (SEQ ID NO:22); H-Tyr(3-Cl)-Tic-Phe-Phe-OH (SEQ ID NO 23); H-Tyr(3-Br)-Tic-Phe-Phe-OH (SEQ ID NO:24); H-Dmt-TicΨ[CH₂—NH]Phe-Phe-OH (SEQ ID NO:25); H-Dmt-TicΨ[CH₂—NH]Phe-Phe-NH₂ (SEQ ID NO:26); H-Tyr-TicΨ[CH₂—NCH₃]Phe-Phe-OH (SEQ ID NO:27); H-Tyr-TicΨ[CH₂—NH]Hfe-Phe-OH (SEQ ID NO:28); Tyr(NMe)-TicΨ[CH₂—NH]Hfe-Phe-OH (SEQ ID NO:29); H-Tyr-Tic-Phg-Phe-OH (SEQ ID NO:30); H-Tyr-Tic-Trp-Phe-OH (SEQ ID NO:31); H-Tyr-Tic-Trp-Phe-NH₂ (SEQ ID NO:32); H-Tyr-Tic-His-Phe-OH (SEQ ID NO:33); H-Tyr-Tic-2-Nal-Phe-OH (SEQ ID NO:34); H-Tyr-Tic-Atc-Phe-OH (SEQ ID NO:35); H-Tyr-Tic-Phe-Phe(pNO₂)-OH (SEQ ID NO:36); H-Tyr-Tic-Trp-Phe(pNO₂)-OH (SEQ ID NO:37); H-Tyr-Tic-Phe-Trp-NH₂ (SEQ ID NO:38); H-Tyr-Tic-Phe-Phe-Val-Val-Gly-NH₂ (SEQ ID NO:39); H-Tyr-Tic-Phe-Phe-Tyr-Pro-Ser-NH₂ (SEQ ID NO:40); H-Tyr-Tic-Trp-Phe-Tyr-Pro-Ser-NH₂ (SEQ ID NO:41); H-Tyr-Tic-Trp-Phe (pNO₂) -Tyr-Pro-Ser-NH₂ (SEQ ID NO:42) and H-Tyr-Tic-Phe-Phe-Leu-Nle-Asp-NH₂ (SEQ ID NO:43)."

At page 25, line 27 through page 26, line 8:

"Abbreviations in the aforementioned peptides of U.S. Patent 5,602,099 may be interpreted as follows: Aib=α-aminoisobutyric acid; Atc=2-aminotetralin-2-carboxylic acid; Boc=tert-butoxycarbonyl; Cpm=cyclopropylmethyl; DCC=dicyclohexyl-carbodiimide; DIEA=diisopropylethylamine; Dmt=2,6-dimethyltyrosine; Et=ethyl; Hex=hexyl; Hfe=homophenylalanine; HOBt=1-hydroxybenzotriazole; MVD=mouse vas deferens; 1-Nal=3-(1'-naphthyl)alanine; 2-Nal=3-(2'-naphthyl)alanine; Phe(pNO₂)=4-nitrophenylalanine; Phg=phenylglycine; Tic=1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid; TIP=H-Tyr-Tic-Phe-OH (SEQ ID NO:44); TIP-NH₂=H-Tyr-Tic-Phe-NH₂ (SEQ ID NO:45); TIP(Ψ)=H-Tyr-

In re: Application of Ekwuribe et al.
Serial No.: 09/429,798
Filed: 29 October 1999
Page 26

Tic Ψ [CH₂-NH]Phe-OH (SEQ ID NO:46); TIPP=H-Tyr-Tic-Phe-Phe-OH (SEQ ID NO:14); TIPP-NH₂=H-Tyr-Tic-Phe-Phe-NH₂ (SEQ ID NO:15); TIPP(Ψ)=H-Tyr-Tic Ψ [CH₂-NH]Phe-Phe-OH (SEQ ID NO:47); Tyr(3-Br)=3-bromotyrosine; Tyr(3-Cl)=3-chlorotyrosine; Tyr(3-F)=3-fluorotyrosine; and Tyr(NaMe)=N α -methyltyrosine."

At page 26, lines 18-20:

"Particularly preferred peptides are endogenous and synthetic Opioid peptides such as the enkephalins. A particularly preferred Opioid is [Met⁵]Enkephalin (Tyr-Gly-Gly-Phe-Met) (SEQ ID NO:48)."

At page 27, lines 16-24:

"In addition to the above types of modifications or substitutions, a mimic of one or more amino acids, otherwise known as a peptide mimetic or [**peptidominetic**] peptidomimetic, can also be used. As used herein, the term "mimic" means an amino acid or an amino acid analog that has the same or similar functional characteristics of an amino acid. Thus, for example, a (D)arginine analog can be a mimic of (D)arginine if the analog contains a side chain having a positive charge at physiological pH, as is characteristic of the guanidinium side chain reactive group of arginine. A peptide mimetic or peptidomimetic is an organic molecule that retains similar peptide chain pharmacophore groups as are present in the corresponding peptide."

At page 27, lines 25-30:

"The substitution of amino acids by non-naturally occurring amino acids and peptidomimetics as described above can enhance the overall activity or properties of an individual peptide based on the modifications to the side chain functionalities. For example, these types of alterations can be employed along with the amphiphilic oligomers of the present invention to further enhance the peptide's stability to enzymatic breakdown and increase the peptide's biological activity."

At page 40, line 6:

"5.2 CONJUGATION OF COMPOUND 2 & 4 WITH [MET-ENKEPHLIN] MET-ENKEPHALIN"

At page 40, lines 14-20:

"To a stirring solution of met-enkephalin (SEQ ID NO:48) (0.130 g; 0.1854 mmol) in 5mL of DMF-DCM (2:1) was added TEA (25 μ L). The reaction mixture was cooled to [10°C] 10°C and a solution of palmityl-teg-nsu or cetyl-teg-nsu dissolved in 1mL of DCM was added in one portion. The reaction mixture was stirred for 2h at [10°C] 10°C. The solvent was removed under reduced pressure and the residue was redissolved in dry ethyl acetate. After evaporation of the solvent 0.310g conjugated enkephalin was obtained. HPLC showed mono & diconjugate oin the ratio of [3.1] 3:1."

At page 41, lines 1-9:

"To a suspension of NaH (4.00g;[:] 0.1 mol) in dry THF (300 mL) at [10°C] 10°C was added diethylene glycol in one portion. The cooling bath was removed and reaction mixture was stirred at room temperature for 2h. At the end the reaction mixture was cooled to [10°C] 10°C and bromohexadecane (29g[)]0.095 mol) was added in one portion. The cooling bath was removed and the reaction was stirred at room temperature for 4h. The solvent was removed under reduced pressure and crude was admixed with water and extracted with ethyl acetate (30 mL x 3). The combined organic extract was sequentially washed with water, brine, dried over MgSO₄ and evaporated to leave white solid powder, single spot on TLC and single molecular ion peak."

At page 41, lines 11-15:

"To a cold stirring solution of phosgene (10.0mL; 20% solution in toluene) under nitrogen, a solution of cetyl-PEG₂-OH (1.3g; 4.00 mmol) in dry dichloromethane (5mL) was added. The reaction mixture was stirred at [0°C] 0°C for 1hr and 2h at room temperature. Excess of phosgene was distilled off using water aspirator, passing through cold solution of dilute NaOH."

At page 41, lines 16-20:

"The reaction flask was cooled in ice bath and equimolar quantity of triethyl amine and a solution of hydroxy succinimide, dissolved in minimum quantity of THF was added slowly. The reaction mixture was stirred at room temperature for 12h. The solvent was removed completely at [25°C] 25°C and residue was redissolved in ethyl acetate, washed with water, brine, dried over MgSO₄ and evaporated to give pure succinimidyl derivative."

At page 41, lines 24-25:

"5.4 CONJUGATION OF SUCCINIMIDYL CETYL-PEG2 WITH BOC-LEU...ENK...LYS-OH (SEQ ID NO:51)"

At page 42, lines 1-3:

"Boc-Leu...enk...Lys-OH (SEQ ID NO:51) (100mg; 0.125 mmol) was dissolved in 5 mL of DMF:DCM(1:1) and stirred at [10°C] 10°C under nitrogen. To this clear solution TEA (17.5 µL) and a solution of succinimidyl cetyl-PEG₂, dissolved in 1 mL of DCM were added".

At page 42, lines 8-9:

"5.4.1 PURIFICATION OF DERIVATIZED BOC-LEU...ENK...LYS-OH (SEQ ID NO:51) ON SILICA GEL COLUMN"

At page 42, lines 10-13:

"The derivatized blocked enkephalin was purified on silica gel column using methanol-chloroform (5% [methnol] methanol-chloroform) mixture as an eluting solvent. After evaporation of desired fraction 100 mg pure compound was obtained. A product yield of 100 mg was obtained after removal of the solvent."

At page 42, lines 14-19:

**"5.4.2 DEBLOCKING OF BUTYLOXYCARBONYL GROUP FROM DERIVATIZED
LEU...ENK (SEQ ID NO:52)**

Derivatized Boc-Leu...enk (SEQ ID NO:52) (100 mg;[:] 0.0866 mmol) was treated with 0.4ml of TFA-DCM (1:1) for 30 min. at room temperature. The solvent was removed under reduced pressure. The solid was redissolved in [2ml] 2 mL of methanol, filtered and evaporated; 80 mg of pure product was obtained."

At page 42, line 23 through page 43, line 10:

"One-hundred milligrams of enkephalin (100 mg; 0.142 mmol) was dissolved in dry dimethylformamide (5 mL) at room temperature. P-nitrophenol or N-hydroxysuccinimide activated (carbonate or ester) of amphiphilic oligomer (1.1 mole equivalent) was dissolved in 1 mL tetrahydrofuran and added to above solution and stirred at room temperature over 1.5 hours. The extent of the reaction was monitored by a reverse phase (C-18) HPLC using isopropanol/water (0.1% [trifluoroacetic] trifluoroacetic acid) gradient system. Reaction mixture was evaporated under reduced pressure and the contents were dissolved in an isopropanol-water mixture. This mixture was purified on a 22 mm preparative HPLC column (C-8) with a solvent gradient system made of either isopropanol/water (0.1% trifluoroacetic acid) or acetonitrile/water (0.1% trifluoroacetic acid to give pure monoconjugated and diconjugated enkephalins. The solvent was evaporated at low temperature ([<20 °C] ≤20°C) to give dry produce. The purity of the product was analyzed by reverse phase analytical HPLC, and the MW information was obtained by MALDI (TOF)-mass spectral technique."

At page 43, lines 17-24:

"Above residue was dissolved in chloroform (50 mL) and to this was added cholesterol (1.05 mole equivalent) in chloroform (50mL) and triethylamine (1 mole equivalent) over 30 minutes at [5 °C] 5°C. The reaction was stirred at [15 °C] 15°C over 2 hours. To this was added N-hydroxysuccinimide (1 mole equivalent) in chloroform (50mL) and followed by triethylamin (1 equivalent) at [5 °C] 5°C and allowed to stir overnight. Solvent was stripped

off and the product was extracted with ethylacetate. Crude product was purified on a silica gel column with 1:10 methanol/chloroform solvent system to obtain activated amphiphilic oligomer in 80% yield."

At page 44, lines 5-6:

"5.7 STABILITY OF MET ENKEPHALIN-LYS (SEQ ID NO:49) (ENKEPHALIN) AND ITS AMPHIPHILIC OLIGOMER CONJUGATES IN RAT BRAIN HOMOGENATE"

At page 44, lines 6-10:

"Met enkephalin-lys (SEQ ID NO:49) and its conjugates (Cetyl-PEG₂, Cetyl-PEG₃ and Palmitate-PEG₃) were incubated in 2% rat brain homogenate. Samples were drawn over time intervals and the amount of the substance remaining was measured by a HPLC method. Following experimental procedure was used for the study."

At page 44, line 11-20:

"Procedure: A 2% rat brain homogenate was prepared by homogenizing freshly perfused (PBS buffer) rat brain in PBS buffer (pH 7.4). Two 3-mL aliquots of the homogenate were equilibrated at [37 °C] 37°C in a water bath. To one unmodified enkephalin was added to other modified (conjugate) was added, resulting in a final concentration of [60ug/mL] 60 µg/mL of peptide. At time 0, 1, 2, 3, 5, 15, 30, and 60 minutes, [200 uL] 200 µL of aliquot was withdrawn and quenched with [200 uL] 200 µL of the quenching agent (1% trifluoroacetic acid in acetonitrile/isopropanol or 1% trichloroacetic acid in water). The sample solutions were vortexed and centrifuged at 7000RPM. The supernatant was analyzed by a HPLC method using a gradient of 10 to 100% isopropanol/water (0.1% trifluoroacetic acid) on a C-18 column."

At page 44, line 21 through page 45, line 2:

"Figure 2 shows the stability of the cetyl-PEG₂-enkephalin (SEQ ID NO:1) conjugate as compared to free met-enkephalin-lys (SEQ ID NO:49). Figure 3 shows the stability of the cetyl-PEG₃-enkephalin (SEQ ID NO:1) as compared to met-enkephalin-lysine (SEQ ID NO:49). Figure 4 shows palmitate-PEG₃-enk (SEQ ID NO:1) (hydrolyzable) conjugate as compared to [met-enkephalin-enk] met-enkephalin-lys (SEQ ID NO:49)."

At page 45, lines 6-7:

"The following procedure was used to identify the presence of conjugate from the brain specimen of animals dosed with 5 mg/kg cetyl-PEG₂-enkephalin (SEQ ID NO:1)."

At page 45, lines 8-19:

"After 10 [~~monutes~~] minutes of dosing, the brain of the animal was perfused with 1.5% trifluoroacetic acid in PBS solution, and the brain was removed and [~~frosen~~] frozen at -70 °C. The brain was homogenized with 1mL of 1.5% trifluoroacetic acid in PBS solution and the homogenate was extracted with acetonitrile/isopropanol solution. The extract was treated with saturated sodium chloride solution and frozen at -20°C for 2 hours.. The organic layer was isolated and centrifuged at 4000RPM. The supernatant was evaporated and the resulting residue was reconstituted in acetonitrile/isopropanol/water mixture. The reconstituted solution was analyzed by HPLC using a gradient of 10 to 100% isopropanol/water (0.1% [~~trifloiroacetic~~] trifluoroacetic acid) on a C-18 column. The presence and the concentration of cetyl-PEG₂-enkephalin (SEQ ID NO:1) conjugate in the extract were measured by comparing the retention time and the peak area of standard solution under the same analytical condition. The results are presented in FIGs 5A to 5D."

At page 45, lines 21-25:

"The results demonstrate that monoconjugates were isolated from brain tissue. FIG 5A shows a peak produced by cetyl enkephalin (SEQ ID NO:1) standard, while 5B shows a corresponding peach demonstrating that cetyl enkephalin (SEQ ID NO:1) was actually

present in the brain extract. In contrast, neither the vehicle (FIG. 5C) nor the unconjugated enkephalin (SEQ ID NO:49) (FIG. 5D) showed a corresponding peak.

At page 46, lines 8-14:

"Met-enkephalin-lys (SEQ ID NO:49) and met-enkephalin-lys derivatives (SEQ ID NO:1) were assessed for analgesic activity by rat paw-hot plate assay. Rats were given an injection of naloxone at 0.5 mg/kg (s.c.) then administered a single administration of cetyl-enkephalin (SEQ ID NO:1) by the tail vein 10 minutes later at a dose of 5.0 mg/kg. The results as graphically displayed in FIG. 6 demonstrate that Naloxone, an μ -receptor antagonist prevents competitively inhibits binding of cetyl-PEG₂-enkephalin (SEQ ID NO:1), thus demonstrating that at least part of the activity of cetyl-PEG₂-enkephalin (SEQ ID NO:1) is attributable to binding at the Opioid μ -receptor."

At page 46, lines 15-16:

"In a separate study, rats were administered cetyl-enkephalin (SEQ ID NO:1) (5.0 mg/kg, i.v.) or clonidine (0.125 mg/kg, i.v.)."

At page 46, line 26 through page 47, line 4:

"The results are displayed in the following tables and in the Graph of FIG 6. The results demonstrate that while 20 mg/kg enkephalin (SEQ ID NO:49) alone has 0% analgesic effect as compared to morphine as a baseline, the enkephalin conjugates of the present invention had strong analgesic effects and one conjugate, DHA-PEG-ENK (SEQ ID NO:1) had 130% of the analgesic effect of morphine. The graph of FIG. 7 shows that CETYL-PEG-ENK (SEQ ID NO:1) produces a response and duration comparable to that of clonidine, an α -adrenergic receptor agonist."

At page 46, please replace the table with the following table:

ANALGESIC EFFECT OF ENKEPHALIN CONJUGATES IN RATS				
Drug or Conjugate	Dose (mg/kg)	Number of Rats	Mean Analgesia as Compared with Morphine at 3 mg/Kg*	
			@ 5 min	@ 30 min
Morphine	3	8	100%	100%
Enkephalin (SEQ ID NO:49)	20	7	0%	0%
Cetyl-PEG-ENK (SEQ ID NO:1)	5	8	84%	75%
DHA-PEG-ENK (SEQ ID NO:1)	20	8	130%	67%
Cholesterol-PEG-ENK (SEQ ID NO:1)	5	8	80%	68%
Linolenic-PEG-ENK (SEQ ID NO:1)	10	8	77%	73%

At page 48, lines 1-22:

"Agonist-stimulated [35 S]GTP γ S autoradiography was performed as described by Sim *et al.* *Proc. Nat'l Acad. Sci. USA* 1992 Pg. 7242 - 7246. Animals were sacrificed by decapitation and brains were removed and frozen in isopentane at [-30 $^{\circ}$ C] -30 $^{\circ}$ C. Coronal and horizontal brain sections were cut on a cryostat maintained at [-20 $^{\circ}$ C] -20 $^{\circ}$ C. Sections were incubated in assay buffer (50 mM Tris-HCl, 3 mM MgCl $_2$, 0.2 mM EGTA, 100 mM NaCl, pH 7.4) at [25 $^{\circ}$ C] 25 $^{\circ}$ C for 10 min. Sections were then incubated in assay buffer containing 2 mM GDP, protease inhibitor cocktail (10 μ l/ml of a solution containing 0.2 mg/ml each of bestatin, leupeptin, pepstatin A and aprotinin), and adenosine deaminase (9.5 mU/ml) at 25 $^{\circ}$ C for 15 min. Section were then incubated in assay buffer with GDP, 0.04 nM [35 S]GTP γ S and appropriate agonist at [25 $^{\circ}$ C] 25 $^{\circ}$ C for 2 hours. The agonists were: 10 μ M DAMGO, 10 μ M

cetyl-enkephalin (SEQ ID NO:1) and 10 [μ]M cetyl-TEG-enkephalin (SEQ ID NO:1).

Basal binding was assessed in the absence of agonist. Slides were rinsed twice for 2 min each in cold Tris buffer (50 mM Tris-HCl, pH 7.4) and once in deionized H₂O. Slides were dried overnight and exposed to film for 72 hours. Films were digitized with a Sony XC-77 video camera and analyzed using the NIH IMAGE program for Macintosh computers.

5.9.3 RESULTS

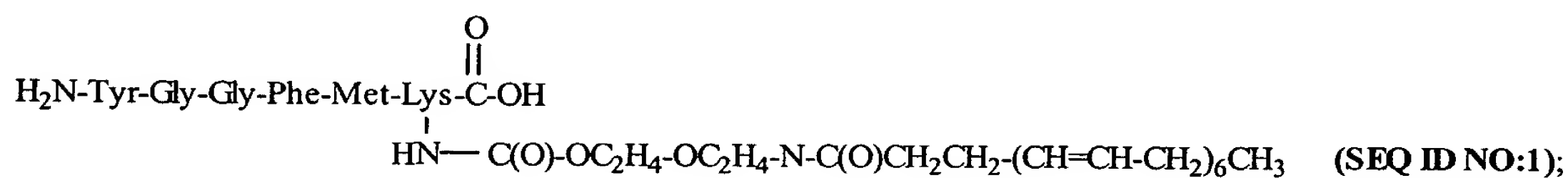
Results show that cetyl-TEG-enkephalin (SEQ ID NO:1) stimulates of [³⁵S]GTP γ S binding. The anatomical distribution of the binding is consistent with that of μ Opioid receptors. These results demonstrate that cetyl-TEG-enkephalin (SEQ ID NO:1) does not simply bind the receptor but also activates the receptor, causing the receptor to bind to G-protein. This activation provides further corroborative evidence that cetyl-TEG-enkephalin (SEQ ID NO:1) directly stimulates analgesia."

In the Claims:

Please amend the claims as follows:

7. (Amended) The amphiphilic drug-oligomer conjugate of claim 1 wherein the therapeutic compound is [met⁵]enkephalin (SEQ ID NO:48).

20. (Amended) An amphiphilic oligomer-enkephalin conjugate selected from the group consisting of:



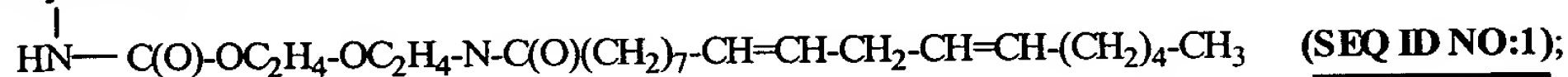
In re: Application of Ekwuribe et al.

Serial No.: 09/429,798

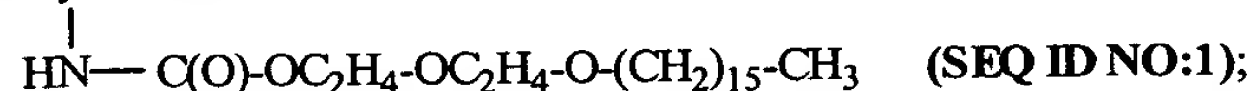
Filed: 29 October 1999

Page 35

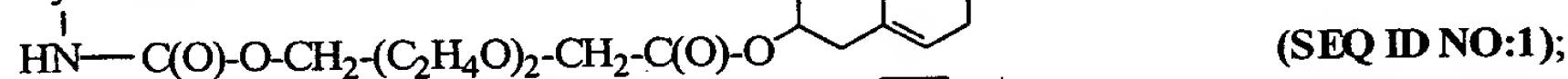
H₂N-Tyr-Gly-Gly-Phe-Met-Lys-COOH



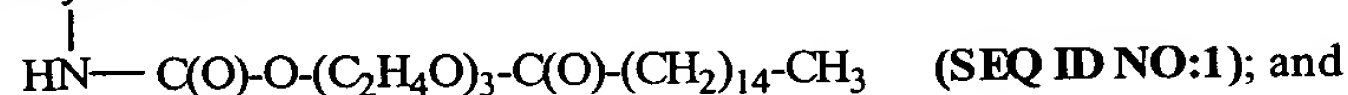
H₂N-Tyr-Gly-Gly-Phe-Met-Lys-COOH



H₂N-Tyr-Gly-Gly-Phe-Met-Lys-COOH

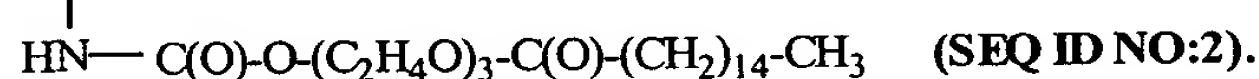


H₂N-Tyr-Gly-Gly-Phe-Met-Lys-COOH



$\text{C(O)-O-(C}_2\text{H}_4\text{O)}_3\text{-C(O)-(CH}_2\text{)}_{14}\text{-CH}_3$

HN-Tyr-Gly-Gly-Phe-Met-Lys-COOH



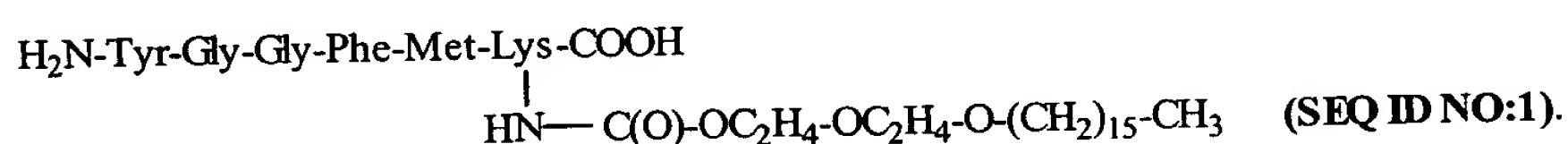
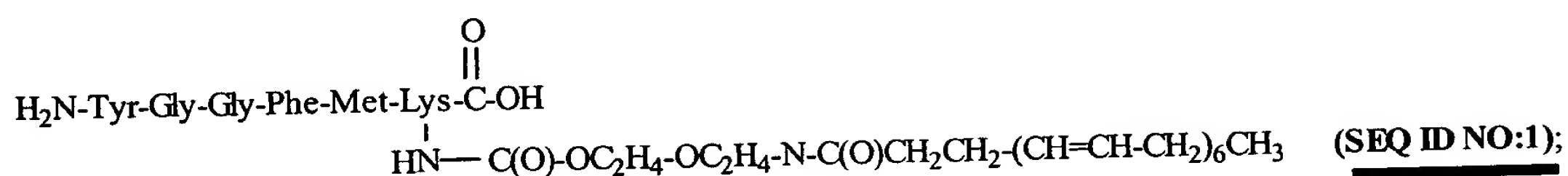
21. (Amended) An amphiphilic oligomer-enkephalin conjugate wherein the oligomer is comprised of a lipophile and a hydrophile and the lipophile is coupled to the hydrophile by a hydrolyzable bond, said conjugate being selected from the group consisting of:

In re: Application of Ekwuribe et al.

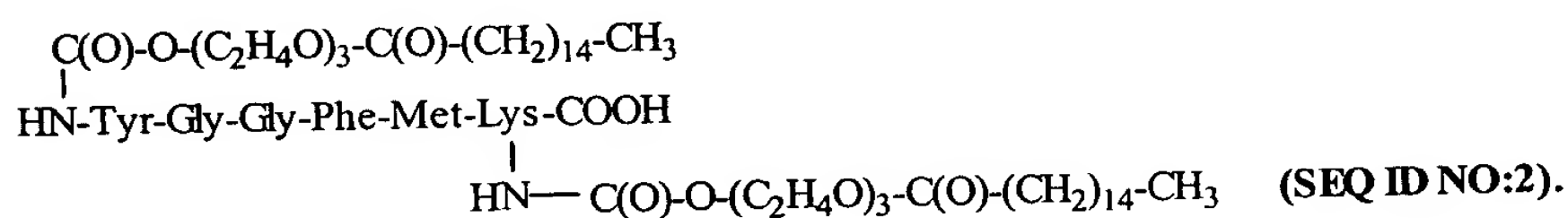
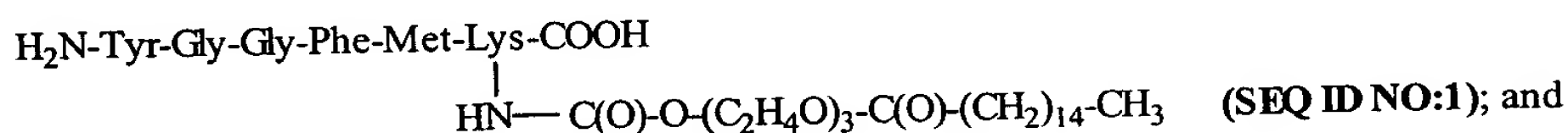
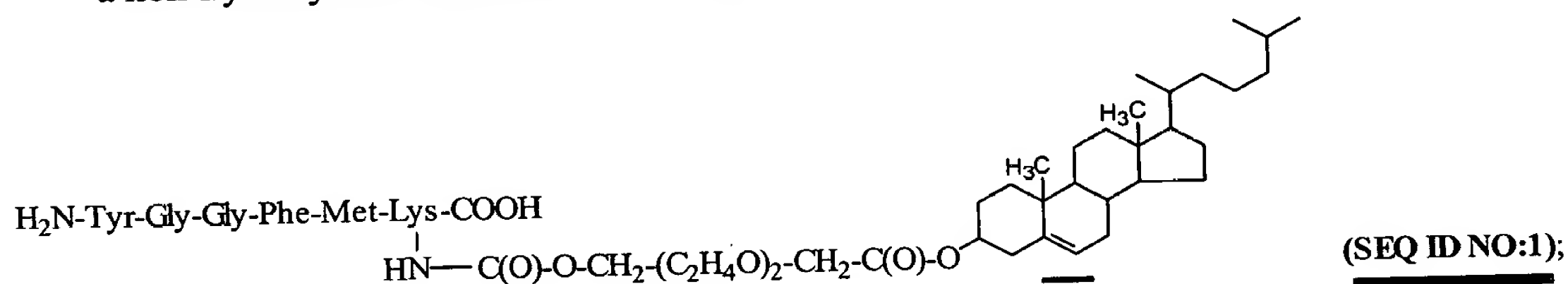
Serial No.: 09/429,798

Filed: 29 October 1999

Page 36



22. (Amended) An amphiphilic oligomer-enkephalin conjugate wherein the oligomer is comprised of a lipophile and a hydrophile and the lipophile is coupled to the hydrophile by a non-hydrolyzable bond, said conjugate being selected from the group consisting of:



In re: Application of Ekwuribe et al.
Serial No.: 09/429,798
Filed: 29 October 1999
Page 37

REMARKS


The amendments above conform the specification and claims to the requests contained in the Office Action mailed March 1, 2001.

Applicants have also taken this opportunity to correct various typographical errors in the specification. For example, at page 25, line 1, the term "Trp-Pro-Lys-His-Xaa-NH₂" has been replaced with the term --Trp-Trp-Pro-Lys-His-Xaa-NH₂-- in order to correct a typographical error. If required, support for this amendment can be found at column 1, line 66-67 of U.S. Patent No. 5,641,861, which was incorporated by reference in the present application.

Applicants have also amended Figures 2-8 to reference sequence ID numbers as requested by the Examiner. Amended Figures 2-8 are enclosed herein.

Any questions regarding the foregoing should be directed to the undersigned, who may be reached at (919) 854-1400.

Respectfully submitted,

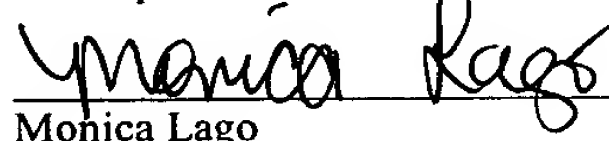


J. Michael Strickland
Registration No. 47,115

Correspondence Address:
USPTO Customer No.: 20792
Myers Bigel Sibley & Sajovec
Post Office Box 37428
Raleigh, NC 27627
Telephone (919) 854-1400
Facsimile (919) 854-1401

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: BOX SEQUENCE Commissioner for Patents, Washington, DC 20231, on March 30, 2001.



Monica Lago

Date of Signature: March 30, 2001